preciable distance on each side of the continuous spectrum, and with an open slit is a large circular disc about 6" in diameter. The same appearance is noticeable in the faint Hγ and very faint Hα lines, but not in other lines.

The section on Temporary Stars has also been very considerably extended by the translator, by the addition of a detailed account of the observations of Nova Aurigæ and of the various theories which have been proposed to account for the manifold phenomena exhibited by this object. The difficulties in the way of accepting any one of these hypotheses as fully satisfactory are pointed out, and it seems impossible to deny that there must have been more than two bodies in action. The complete transformation of the spectrum at the revival of the star, so strikingly similar to that discovered by Copeland in the case of Nova Cygni, is also an awkward fact to deal with, and one that cannot be avoided by merely denying that we have here "a star turned into a planetary nebula." The interpretation of the nebulous appearance of the star as caused simply by the chromatic aberration of the blue hydrogen rays, when the telescope is focussed for the most intensive rays of the chief nebular line 5002, seems untenable, as so experienced and sharp-sighted an observer as Prof. Barnard has recently declared himself to be absolutely sure, that the nebulous appearance is not a mere telescopic effect (*Astr. Nach.* 3238). And why should we think it impossible for the object to *look* like a nebula, when it has the unmistakable spectrum of one, and when we remember the above-mentioned observation by Campbell of D.M. 30°, 3639? The objects which caused the outburst in December 1891 probably left the scene of the catastrophe a few months after, leaving behind them masses of gas both visually and spectroscopically seen as a nebula. But, as pointed out by Prof. Frost, the most difficult facts to explain are the enormous relative velocities of the objects.

The study of the spectra of Type III*a* has, during the last few years, produced results which have very much lessened the supposed similarity between these spectra and those of sun-spots, and the development of bright lines in many spectra of long-period variables at their epochs of maximum obliges us to give up the ideas which formerly prevailed with regard to these variables. Here, as in the case of Nova Aurigæ and β Lyræ, we have evidently to do with very complex phenomena. The translator refers in a few words to the theory advanced by Mr. Lockyer, that the long-period variables may be systems of two swarms of meteorites revolving in elliptical orbits, and he dismisses it with the objection (which is not new) that the conditions in a system of this kind could not be permanent, as with successive collisions the smaller swarm would become spread out into a ring, thus causing the variability to cease. This objection is, however, not a serious one, as our own Leonids, though spread out into a ring, have for many centuries exhibited a very strongly marked maximum.

After describing the spectra of Type III*b*, the translator gives a summary of Pickering's statistical examination of the Draper Catalogue. He has omitted the short notice of the Meteoritic Hypothesis which Dr. Scheiner had inserted at the end of this chapter, and which hardly gave a fair idea of the hypothesis. The two remaining chapters are devoted to the spectra of the Aurora and Zodiacal Light, and the displacements of spectral lines as caused by the rotation of the sun, the motion of stars in the line of sight, or by spectroscopic binaries. A useful addition is given in the shape of a reprint of Campbell's formulæ and tables for the reduction of observations of displacement.

The fourth part of the book (pp. 361–426) contains a very valuable set of spectroscopic tables, viz. Rowland's new table of standard wave-lengths (*Astronomy and Astrophysics*, April 1893), Abney's wave-lengths of lines in the ultra-red spectrum, Kayser's and Runge's arc spectrum of iron, a catalogue of stars of classes III*a* and III*b*, and, lastly, an unpublished partial revision of the chromospheric lines by Young. Finally, on pp. 427–472, a bibliographical list is given of books and papers relating to astronomical spectroscopy. This list is unfortunately very incomplete, and glaringly so with regard to solar phenomena. We have, also, in several cases missed references to papers quoted in the body of the book, and in others only found references to short notices in NATURE, instead of to original memoirs.

On the whole, this English revised edition is a great improvement on the original, valuable as the latter undoubtedly was, and it forms both an excellent text-book for the student and a useful book of reference to workers in spectroscopy.

J. L. E. DREYER.

AGRICULTURAL ZOOLOGY.

Agricultural Zoology. By Dr. J. Ritzema Bos, Lecturer in the Royal Agricultural College, Wageninen, Holland. Translated by J. R. Ainsworth Davis, B.A. With an introduction by Eleanor A. Ormerod. (London: Chapman and Hall, 1894.)

AGRICULTURISTS will be misled by the title of this book, if they expect to find any reference in it to farm animals which especially interest and concern them, such as horses, cattle, sheep, and pigs. There are no descriptions of these animals in this work upon agricultural zoology, although after having enumerated the thirteen orders of mammals, Dr. Ritzema Bos says he shall "deal only with those of agricultural importance," and forthwith leaves out all references to cattle, horses, sheep and pigs. But, on the other hand, such animals as wild boars, deer, otters, golden eagles, nightingales, herring-gulls, and grebes, having no connection with agriculture, are treated of at some length, and figures of them are given. Cuttle-fishes and star-fishes also seem out of place in a work entitled "Agricultural Zoology," which should rather have been styled "Zoology, or the Elements of Zoology."

Among the insects the migratory grasshopper (*Acridium migratorius*) and the Colorado beetle (*Doryphora decemlineata*) figure, though these are not British insects, nor are they likely ever to gain a foothold in this country. A work upon British Agricultural Zoology is much wanted that would give the cultivators accurate information upon all the animals that are in any way, directly or indirectly, serviceable to them, and all those that are harmful to them, directly or indirectly. Dr. Ritzema Bos just touches the fringe of this subject with regard to the larger animals, though, it must be admitted, he goes into rather more detail concerning insects. Knowledge of the inner life of animals is most desirable, and should be spread through the whole of the country districts by the Technical Education Committees of County Councils, by means of competent lecturers, in the absence of any standard text-book on the subject. There is a capital book on Agricultural Zoology in France, compiled by Dr. Brocchi, entitled "Traité de Zoologie Agricole," in which detailed descriptions are given of all the animals that are useful and injurious to cultivators. Their habits (*mœurs*) are first detailed, then their use (*utilité*), or the harm (*dégâts*) occasioned by them, so that one may see at a glance those that may be counted upon as friends or foes. It might be supposed naturally that in a treatise upon Agricultural Zoology, Dr. Ritzema Bos would have dealt at some length with, for instance, such a useful bird as the kestrel (*Falco tinnunculus*), which must be held to be one of the best friends of the farmer, for it feeds upon mice, rats, and cockchafers. Swallows, martins, and swifts are dismissed with exceedingly short notices, and their indescribably good services to cultivators are unfairly depreciated in the following inconsistent passage:—

> "Swallows fly quickly and catch insects while on the wing. The insects on which they prey are generally unimportant to agriculture and forestry; but they may also do good by catching crane-flies (Tipula) and ribbon-footed corn-flies (Chlorops), which often fly about our fields in enormous swarms in order to lay their eggs."

It must be strenuously denied that the insects on which they prey are unimportant to agriculture, as they are known to be especially fond of aphides, and many hop-planters believe that the far greater frequency of the attacks of the *Phorodon* (*aphis*) *humuli* upon hop-plants in the last five years is due in a degree to the scarcity of swallows and martins. There is no doubt, also, that these birds clear off the Hessian fly, *Cecidomyia tritici*, and others of the *Cecidomyidæ*, and as they live entirely on insects, and especially on the smaller and most dangerous insects, they are of inestimable benefit, and should therefore be preserved with religious care. It is much to be lamented that swallows, martins, and swifts are so ruthlessly massacred in the sunny climes in which they pass the winter seasons. Plovers, too, whose value to farmers is inestimable, are not alluded to. This is an unfortunate omission, as it is desirable to clearly point out that these birds should be encouraged, and that the general raids upon their eggs, to satisfy the appetites of gourmets, should be stopped.

In his large, valuable work, "Tierische Schadlinge und Nützlinge für Ackerbau, Viehzucht, Wald- und Gartenbau," published at Berlin in 1891, Dr. Ritzema Bos, like Dr. Brocchi, gives full accounts of all animals in any way connected with the field, forest, and garden, and this might have been liberally epitomised and translated for the benefit of British agriculturists with far more advantage to them than the unsatisfactory *réchauffée* now before us. Insects are Dr. Ritzema Bos's strong point, as all are aware who know his labours in this direction, so that it is not surprising to find considerably more than a third of the contents of "Agricultural Zoology" devoted to them. But it is rather strange that some very important insects are not mentioned, and that others are dismissed with a short account of their habits. In some cases methods of prevention and remedies against insect attacks are suggested, but they are generally given in the briefest possible manner. Thus for the pea-weevil (*Sitones lineatus*) the remedy prescribed is "rational rotation," which will convey little or no meaning to the perplexed pea-grower.

For the ravages of the Diamond-back Moth (*Plutella cruciferarum*), no remedy whatever is mentioned, although the caterpillars of this insect occasionally do serious harm to many species of the Brassica, as in 1891, when many thousands of acres of turnips, rape, and cabbages were ruined by their action.

Another instance of a curious remedy may be given in the paragraph upon Cockchafers (*Melolontha vulgaris*) in which it is recommended that the grubs that are turned up during ploughing should be collected, and that the cockchafers should be caught. "This is very expensive, since it has to be done very energetically if most of them have left the pupa case. A part of the expense may, however, be recouped by using the cockchafers as manure." This "part of the expense," it is thought, would be absurdly infinitesimal.

Again, for the Red Spider (*Tetranychus telarius*), most destructive to many crops of the farm, garden, and glass-house, no modes of prevention or remedial measures are hinted at, although economic entomologists have pointed out that as moisture is most obnoxious to these mites, washing or spraying infested plants frequently is an efficacious remedy against them. One of the best parts of this volume is that devoted to the *Anguillulidæ*, or eelworms, which are most injurious to a number of crops, and in many cases are quite unsuspected enemies.

With regard to the insects omitted, it will be seen that none that are injurious to fruit crops have been included, though fruit-growing forms an important feature of British land culture. As in Holland and Germany, the Winter Moth (*Cheimatobia brumata*) is terribly destructive to the apple crops in this country, and the Codlin Moth (*Carpocapsa pomonella*) is almost equally injurious in some seasons to apple-trees in Great Britain, the Continent, and the United States and Canada. Both these are unnoticed, as well as several other moths, and many weevils and sawflies, that attack apple, pear, and plum trees, gooseberry and currant bushes, and raspberry-canes, against whose onslaughts fruit-growers would only be too thankful to have some practical advice from an expert of the reputation of Dr. Ritzema Bos.

In a few instances valuable remedies are recommended against insects, as, for example, the remedy adopted for the Silver Y Moth (*Plusia gamma*), by fastening together by laths several long troughs with steep inner walls, at distances equal to those between the adjacent furrows, and the caterpillars are swept by besoms fixed to the laths into the troughs, from which they are collected in sacks at the end of the furrows. With this cheap machine about twelve acres per day can be cleared. This is a practical remedy, and is derived from Taschenberg, the most practical and able of all economic entomologists, who has done more for cultivators in the way of describing insects, and prescribing methods of prevention and remedial measures against them, than any other entomologist; and whose store of information many writers upon economic entomology have calmly used without acknowledgment. His "Praktische Insekten-Kunde" is a model of what a work upon baneful insects should be.

The 149 illustrations in "Agricultural Zoology" are good, especially those from Taschenberg, which are very clear, and some of these form very pretty pictures. It would be a great assistance to readers if an index had been supplied, for it is difficult to find references that are required.

Upon the whole we cannot congratulate Prof. Ritzema Bos upon his last production. If he had reproduced parts of his larger work, "Tierische Schadlinge und Nützlinge," without alteration, it would have been far better than boiling it down and entitling the result "Agricultural Zoology."

OUR BOOK SHELF.

Progress in Flying Machines. By O. Chanute, C.E. (London: Messrs. Sampson Low, Marston, and Co., 1894.)

THIS book is a reissue of a series of twenty-seven articles which appeared in *The Railroad and Engineering Journal* (now re-designated as *The American Engineer*) of New York City. It gives a very complete account of the many experiments that have been performed by various experimenters with details of the machines used, and clear reasons why so many of them have failed. After a short statement of general principles the author describes the machines in which wings and parachutes were used; then those in which screws were used to lift and to propel. The author believes that the true function of aerial screws is to propel and not to lift (page 72); but Lord Kelvin, in the discussion on aerial navigation at the British Association in Oxford, last August, stated his belief in screws working round a vertical axis for the latter purpose. The greater part of the book is devoted to a description and discussion of aeroplanes. The whole subject of aerial navigation resolves itself into ten problems or conditions:

(1) The resistance and supporting power of the air.

(2) The motor, its character and its activity.

(3) Selection of the instrument to obtain propulsion.

(4) The form and kind of the apparatus for sustaining the weight—whether flapping wings, screws, or aeroplanes.

(5) The amount of the sustaining surface required.

(6) The best materials to be employed for the framing and for the moving parts.

(7) The maintenance of the equilibrium, which is the most important, and perhaps the most difficult of solution, of all the problems.

(8) The guidance in any desired direction.

(9) The starting up into the air under all conditions.

(10) The alighting safely anywhere. Safety in starting up, in sailing, and in coming down is essential.

All these problems are fully and fairly discussed in this volume. There are eighty-two diagrams, and an excellent index, which add greatly to the value of the book.

Fertilisers and Feeding Stuffs; their Properties and Uses. By Bernard Dyer, D.Sc. (Lond.) (London: C. Lockwood and Co., 1894.)

THIS little book, which is a handbook for practical farmers, and is not addressed to the agricultural student, is issued opportunely. It contains the full text of the Fertilisers and Feeding Stuffs Act 1893, and the Regulations and Forms of the Board of Agriculture relating to the same, and also some useful notes on the Act, by Mr. A. J. David, Barrister-at-Law. Dr. Dyer's notes were first published in the form of newspaper articles, and have been reprinted by request; they will prove very useful to the class to whom they are addressed, containing as they do short descriptions of the origin, composition, and uses of farmyard manure, artificial manures, and of purchased feeding stuffs, all of a practical nature. The notes on the new "Fertilisers and Feeding Stuffs Act" will also be useful to those who wish to put this Act into use; but these, we anticipate, will be few.

Heat treated Experimentally. By Linnaeus Cumming, M.A. (London: Longmans, Green, and Co., 1894.)

THE companion volume to this—"Electricity treated Experimentally"—is known to most teachers of physics. The present work aims at giving (1) an elementary account, with easy experiments, of the general laws of heat; (2) a brief account of the classic researches of Regnault, Joule, and other eminent investigators; (3) a description of the theory of heat comprehensible to students whose mathematical range does not extend beyond elementary trigonometry. This laudable design is satisfactorily realised. Mr. Cumming writes clearly; in other words, he knows what to say and how to say it. The experiments described are all workable and well arranged, hence the book is one which may be used in science classes with confidence and pleasure.

Ways and Works in India. By G. W. Macgeorge, M.I.C.E. (Westminster: Constable and Co., 1894.)

AN account of the public works in India from the earliest times up to the present day should be useful, if only as an outline for a precise and detailed history of Indian Public Works. The materials for the compilation before us have been collected by the author from various official publications, and the facts are arranged in a satisfactory manner. The subjects treated are the trigonometrical survey of India; roads; irrigation works; railways; water-supply of towns; internal telegraphic system; and sea and harbour works. The data referring to these matters will be valuable to all interested in the progress of India. The work does not appeal to a large public in England; nevertheless, it presents, in a readable form, much useful information on the engineering works which will stand for many years as monuments to British rule in India.

Manual Pratique de L'Aéronaute. By W. de Fonvielle. (Paris: Bernard Tignol.)

IN this book of 246 pages, M. de Fonvielle, a well-known writer on aeronautical matters, contrives to compress a mass of information of use to the aeronaut. We recommend the book to practical aeronauts, meteorologists, and the numerous amateurs who are interested in ballooning and its possibilities. Seventy figures illustrate the text. It has been said that the development of the art of flying has been retarded by the balloon; but even if this is conceded, M. de Fonvielle's book shows that science has gained a little from ballooning.

Fruit Culture for Profit. By C. B. Whitehead, B.A. Pp. 68. (London: Society for Promoting Christian Knowledge, 1894.)

IN view of the recent correspondence in the *Times*, on fruit culture, this book appears very opportunely. Fruit-growing is now recognised as a valuable branch of agriculture, and English producers are becoming alive to its importance. The Royal Agricultural Society and the Board of Agriculture have encouraged fruit-growing by publishing articles and pamphlets upon the subject. These publications, and Mr. Whitehead's little volume, should be obtained by all who are interested in the profitable production of fruit.